

Claims

1. A method for estimating altitude of a communications device, comprising the step of:

estimating the altitude of the communications device based at least on altitude of at least one antenna of a communications system, said communications device communicating with the communications system via said at least one antenna.

2. A method as defined in claim 1, wherein the altitude estimation is based at least on altitudes of at least two antennas of the communications system, said communications device communicating with the communications system via said at least two antennas.

3. A method as defined in claim 2, wherein the altitude estimation is an average of altitudes of said at least two antennas.

4. A method as defined in claim 2, further comprising a step of providing a two-dimensional location estimate of the communications device and antenna information representing three-dimensional locations of said at least two antennas, the altitude estimation being based on said two-dimensional location estimate of the communications device and on said antenna information.

5. A method as defined in claim 4, further comprising the step of estimating said two-dimensional location estimate for the communications

device based on information relating to said at least two antennas of said communication system.

6. A method as defined in claim 5, wherein said two-dimensional location estimate for the communications device is determined based on signal measurements relating to said at least two antennas of said communications system.

7. A method as defined in claim 6, wherein said signal measurements include at least one of the following: signal timing measurements, signal strength measurements and direction of arrival measurements.

8. A method as defined in claim 5, wherein said two-dimensional location estimate for the communications device is determined based on identity information of at least two cells corresponding to said at least two antennas of said communications system.

9. A method as defined in claim 5, further comprising the step of estimating accuracy of the altitude estimate of the communications device.

10. A method as defined in claim 4, wherein the altitude estimation uses a weighted average of altitudes of said at least two antennas, each weight taking into account said two-dimensional location estimate of the communications device and a two-dimensional location of an antenna of said communications device.

11. A method as defined in claim 10, wherein each weight in the weighted average is inversely proportional to a distance between the two-dimensional location estimate of the communications device and the two-dimensional location of an antenna of said communications system.
12. A method as defined in claim 10, further comprising the step of estimating said two-dimensional location estimate for the communications device based on information relating to said at least two antennas of said communication system.
13. A method as defined in claim 12, further comprising the step of estimating accuracy of the altitude estimate of the communications device.
14. A method as defined in claim 4, wherein the altitude estimation is determined by projecting the two-dimensional location estimate of the communications device to a reference plane determined using said antenna information.
15. A method as defined in claim 14, wherein the reference plane intersects points defined by said antenna information.
16. A method as defined in claim 14, wherein the reference plane is a regression plane relating to points defined by said antenna information.

17. A method as defined in claim 14, further comprising the step of estimating said two-dimensional location estimate for the communications device based on information relating to said at least two antennas of said communication system.

18. A method as defined in claim 17, further comprising the step of estimating accuracy of the altitude estimate of the communications device.

19. A method as defined in claim 18, wherein the accuracy of the altitude estimate of the communications device is estimated using said reference plane.

20. A method as defined in claim 1, wherein said altitude of said at least one antenna represents said at least one antenna at a ground level.

21. A method as defined in claim 1, wherein said altitude of said at least one antenna represents said at least one antenna above a ground level.

22. A method for providing location assistance information to a communications device communicating with a communications system via at least one antenna of said communications system, said method comprising:

estimating an altitude estimate for the communications device based at least on altitude information of said at least one antenna; and

determining location assistance information based on a two-dimensional location estimate and the altitude estimate for the communications device.

23. A method as defined in claim 22, further comprising the step of estimating said two-dimensional location estimate based on information based on information relating to said at least one antenna of said communication system.

24. A method as defined in claim 23, further comprising the step of estimating an accuracy of the altitude estimate, wherein the accuracy of the altitude estimate is included in the location assistance information.

25. A method as defined in claim 23, wherein said antenna information represents three-dimensional locations of said at least two antennas, the altitude estimation being based on said two-dimensional location estimate of the communications device and on said antenna information.

26. A method as defined in claim 25, wherein the altitude estimation uses a weighted average of altitudes of said at least two antennas, each weight taking into account said two-dimensional location estimate of the communications device and a two-dimensional location of an antenna of said communications device.

27. A method as defined in claim 25, wherein the altitude estimation is determined by projecting the two-dimensional location estimate of the communications device to a reference plane determined using said antenna information.

28. A communications system, said communications system comprising:

storage means for storing antenna information representing at least altitudes of antennas of said communications system; and

first estimation means for estimating an altitude of a communications device communicating with the communications system via at least one antenna of said communications system, said altitude estimation being based at least on altitude of said at least one antenna of said communications system.

29. A communications system as defined in claim 28, further comprising:

second estimation means for estimating a two-dimensional location estimate of the communications device communicating with the communications system via said at least one antenna of the communications system; and

determination means for determining location assistance information based on said two-dimensional location estimate and said altitude estimate of the communications device.

30. A communications system as defined in claim 28, further comprising:

second estimation means for estimating a two-dimensional location estimate of the communications device communicating with the

communications system via at least two antennas of the communications system,

wherein said antenna information represents three-dimensional locations of antennas of said communications system and said first estimation means are arranged to estimate altitude of the communications device based on said two-dimensional location estimate of the communications device and on said antenna information relating to said at least two antennas of the communications system.

31. A communications system as defined in claim 30, further comprising:

determination means for determining location assistance information based on said two-dimensional location estimate and said altitude estimate of the communications device.

32. A communications system as defined in claim 28, further comprising:

third estimation means for estimating accuracy of said altitude estimate for a communications device.

33. A communications system as defined in claim 28, wherein the communications system comprises a cellular telecommunications system.

34. A network element for a communications system, said network element comprising:

first determination means for determining antenna information representing at least altitudes of antennas of said communications system; and

first estimation means for estimating an altitude of a communications device communicating with the communications system via at least one antenna of the communications system, said altitude estimation being based at least on altitude of said at least one antenna of said communications system.

35. A network element as defined in claim 34, further comprising:

second determination means for determining a two-dimensional location estimate for the communications device, and

third determination means for determining location assistance information based on said two-dimensional location estimate and said altitude estimate of the communications device.

36. A network element as defined in claim 34, further comprising:

second determination means for determining a two-dimensional location estimate for the communications device,

wherein said antenna information represents three-dimensional locations of antennas of said communications system and said first estimation means are arranged to estimate altitude of the communications device based on said two-dimensional location estimate of the communications device and on said antenna information relating to at least two antennas of the communications system, said communications device communicating with the communications system via said at least two antennas.

37. A network element as defined in claim 36, further comprising:
- third determination means for determining location assistance information based on said two-dimensional location estimate and said altitude estimate of the communications device.
38. A network element as defined in claim 34, further comprising:
- second estimation means for estimating accuracy of said altitude estimate for a communications device.
39. A network element as defined in claim 34, wherein the network element comprises a location server.
40. A network element as defined in claim 34, wherein the network element comprises a network element responsible for radio resource control of a cellular telecommunications network.